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TITLE: Method of repairing/reinforcing existing structures and anisotropic woven fabrics used therefor

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CLAIMS:

What is claimed is:

1. A method of repairing and reinforcing a preexisting structure, comprising the steps of:

providing a reactive mixture which comprised as its chief components (1) a monomer having vinyl groups an (2) a reactive oligomer having vinyl groups and/or a thermoplastic polymer and has a gelling time of 15 minutes or more a 20.degree. C., the polymerization of which is capable of being initiated even at a temperature of 5.degree. C. and which is curable in a period of time of 6 hours or less, even at a temperature of 5.degree. C.;

applying the reactive mixture to the preexisting structure while impregnating a sheet material comprising reinforcement fibers with the applied mixture at a temperature at the place of use; and

curing the reactive mixture to form a fiber-reinforced resin layer.

2. The method of claim 1, wherein the reactive mixture contains a component (1) comprising at least one type of (meth)acrylate monomer, and a component (2) comprising a reactive oligomer having at least 1 (meth)acrylic group within the molecule and/or a thermoplastic polymer.

3. The method of claim 2, wherein the reactive oligomer contained in the reactive mixture as component (2) comprises a reactive oligomer having at least one (meth)acrylic group and allyl ether group in the molecule.

4. The method of claim 3, wherein the reactive oligomer contained in the reactive

mixture as component (2) comprises a polyester (meth)acrylate containing allyl ether groups which is obtained by the reaction of a polybasic acid, a polyhydric alcohol, an alcohol containing allyl ether groups, and (meth)acrylic acid.

5. The method of claim 3, wherein the reactive oligomer contained in the reactive mixture as component (2) comprises an epoxy (meth)acrylate containing allyl ether groups which is obtained by the reaction of a polybasic acid, an epoxy resin, an alcohol containing allyl ether groups, and (meth)acrylic acid.

6. The method of claim 5, wherein phthalic acid is the polybasic acid, bisphenol A and/or bisphenol F epoxy resin having an epoxy equivalent of 970 or less is the epoxy resin, and pentaerythritol triallylether is the alcohol containing allyl ether groups.

7. The method of claim 2, wherein the reactive oligomer contained in the reactive mixture as component (2) comprises an epoxy (meth)acrylate obtained by the reaction of an epoxy resin and (meth)acrylic acid.

8. The method of claim 2, wherein the reactive mixture has a viscosity of 5-10.sup.4 centipoise at 20.degree. C.

9. The method of claim 2, wherein the reactive mixture has a viscosity within a range of 5-800 centipoise at 20.degree. C.

10. The method of claim 2, wherein the reactive mixture contains paraffin wax.

11. The method of claim 1, wherein an organic peroxide which is individually stable at room temperature (the temperature at the place of use or the like), and a curing promoter which makes possible the breakdown of this organic peroxide at room temperature, are added to the reactive mixture.

12. The method of claim 11, wherein a reactive mixture in which the organic peroxide and the curing promoter are uniformly mixed is applied to a surface of a portion on which repair and reinforcement is to be conducted;

the sheet material comprising reinforcement fibers is applied to the surface to which the reactive mixture has been applied; and

the same mixture is impregnated from the opposite side and allowed to cure.

13. The method of claim 11, wherein a reactive mixture (A) containing the organic peroxide but not containing the curing promoter is mixed with a reactive mixture (B) containing the curing promoter but not containing the organic peroxide, and the mixture obtained is applied to a surface of a portion on which repair and reinforcement is to be conducted;

the sheet material comprising reinforcement fibers is applied to the surface to which the reactive mixture has been applied; and

a reactive mixture (A) containing the organic peroxide but not containing the curing promoter is mixed with a reactive mixture (B) containing the curing promoter but not containing the organic peroxide, and the mixture obtained is applied to an outer surface of the sheet material and allowed to cure.

14. The method of claim 11, wherein a first mixture (A) containing the organic peroxide but not containing the curing promoter and a reactive mixture (B) containing the curing promoter but not containing the organic peroxide, is applied to a surface of a portion on which repair and reinforcement is to be conducted;

the sheet material comprising reinforcement fibers is applied to the surface to which one reactive mixture has been applied; and

a second mixture, which is the other of the reactive mixture (A) or the reactive mixture (B), is impregnated into the sheet material thereby resulting in contact and mixing of the reactive mixture (A) and the reactive mixture (B), and the mixture obtained of the reactive mixture (A) and the reactive mixture (B) is allowed to cure.

15. The method of claim 11, wherein a compound (a), which is one of the organic peroxide and the curing promoter, is deposited in advance on the sheet material comprising reinforcement fibers; and

during execution, a mixture containing the other of the organic peroxide or the curing promoter, but not containing the compound (a), is impregnated into the sheet material and allowed to cure.

16. The method of claim 11, wherein a first mixture, which is one of a reactive mixture (A) containing the organic peroxide but not containing the curing promoter and a reactive mixture (B) containing the curing promoter but not containing the organic peroxide, is applied to a surface of a portion on which repair and reinforcement is to be conducted;

the sheet material comprising reinforcement fibers is applied to the surface to which the first reactive mixture has been applied;

a second mixture, which is the other of the reactive mixture (A) or the reactive mixture (B), is impregnated into the sheet material; and

the first mixture is further impregnated into the sheet material which results in contact and mixing of the reactive mixture (A) and the reactive mixture (B), and the mixture obtained of the reactive mixture (A) and the reactive mixture (B) is allowed to cure.

17. The method of claim 1, wherein the sheet material comprising reinforcement fibers comprises a sheet material, wherein a heat-fusible cloth is heat-fused to at least one surface of a sheet material comprising reinforcement fibers oriented in one direction.

18. The method of claim 1, wherein the sheet material comprising reinforcement fibers comprises a sheet material, in which heat-fusible fibers are disposed at at least one surface of a sheet material comprising reinforcement fibers oriented in a single direction, in a direction perpendicular to that of the reinforcement fibers and with a spacing within a range of 3-15 mm in the longitudinal direction of the reinforcement fibers, and are heat-fused to this surface.

19. The method of claim 1, wherein said sheet material comprising reinforcement fibers comprises an anisotropic textile, wherein heat-fusible fibers are disposed at and heat-fused to at least one surface of a sheet material comprising reinforcement fibers oriented in one direction, oriented in a direction perpendicular to that of the reinforcement fibers and with a spacing within a range of 3-15 mm in the longitudinal direction of the reinforcement fibers.

20. The method of claim 1, wherein said sheet material comprising reinforcement fibers comprises an anisotropic textile, employing high strength and highly elastic fibers (reinforcement fibers) having a tensile strength of 3 GPa or more and a tensile elastic modulus of 150 GPa or more as the warp, the fibers having a tensile elastic modulus lower than that of the warp as the weft, wherein the weft threads comprise composite threads having a weight of 0.1 g or less per meter and comprising two types of fibers having a melting point difference of 50.degree. C. or more, and the spacing of the weft threads in the warp direction is within a range of 3-15 mm, and by means of the low melting joint fibers comprising the weft, the warp and weft adhere to one another.

21. The method of claim 1, wherein the sheet material comprises reinforcement fibers arranged in one direction and fibers disposed so as to cross the reinforcement fibers.

22. The method of claim 1, wherein the reactive mixture comprises a curing catalyst for radical polymerization at a temperature at the place of use.

23. The method of claim 1, wherein the preexisting structure is selected from the group consisting of bridges, columns, piers, and buildings.

24. The method of claim 1, wherein the preexisting structure comprises concrete.